

ALLEGRO MICROSYSTEMS, INC.

WASTEWATER TREATMENT SYSTEM COMPONENTS & OPERATING
CONTROLS

A. Overview

Wastewaters generated from Allegro process operations require pretreatment to meet the District wastewater discharge permit. Wastestreams from integrated circuits and semiconductor manufacturing operations are presently treated by a pH neutralization system prior to discharging to the District's wastewater facility.

Wastewaters from process operations flow by gravity to a 2080 gallon pH treatment process wastewater tank (TK-1) located in a pit below the wastewater treatment area. The waste stream is generally acidic, varying between 1.3 and 5.0 with slugs of high pH during regeneration of the deionized water (DI) system. The DI regenerant waste is currently being stored in a regenerant waste storage tank (TK-6) located outside the DI building. Low pH is primarily due to acids used in the manufacturing process. In the TK-1 tank a pH probe monitors wastewater pH and automatically signals the pH controller when caustic is required. Wastewater from tank TK-1 is pumped, with vertical centrifugal lift pumps (P1, P2, P3 and P4) to pH treatment buffer tank (T-2) and flows by gravity to pH treatment buffer tank T-3. In the buffer tanks a pH probe will monitor the pH of the contents and automatically signal the pH controller when acid or caustic is required.

Treated effluent subsequently flows by gravity to the District sewerage system or is pumped through an energy recovery heat exchanger that warms water feeding the DI water purification system. As required by the conditions of Allegro's existing discharge permit, a final effluent pH monitor with recorder and a sampling point are installed after the pH neutralization system and prior to discharge to the District sewerage system.

B. Treatment System Design

The pH treatment process is equipped to treat 600 gallons per minute instantaneous flow (840,000 GPD) which is greater than 120% of the design maximum daily flow of 157 gallons per minute (226,000 GPD) and the system average daily flow is typically 78 gallons per minute (113,000 GPD). The neutralization process has the capacity to deliver up to 3.4 lbmol equivalents per minute of base to neutralize acids and to deliver up to 0.36 lbmol equivalents per minute of acid to neutralize bases. The system does treat hazardous industrial waste water and therefore is subject to the requirements of 310 CMR 30.605. The Facility has an Integrated Contingency Plan that addresses hazard assessment and emergency planning. The treatment system design as configured in January 2008 has been reviewed by Massachusetts Registered Professional Engineer (MAPE). If the treatment system is modified, its revised plans shall be reviewed, stamped and signed by a MAPE.

C. pH Treatment Process Wastewater Tank (TK-1)

Wastewater flows by gravity and regenerant waste is pumped to the pH treatment process wastewater tank TK-1. Tank TK-1 is located in a pit which is equipped with both an air diaphragm pump and an optional gasoline driven self-priming centrifugal pump to remove the spillage in case of an overflow. Tank TK-1 is equipped with one (1) pH probe and controller which controls chemical additions. Since the waste stream in tank TK-1 is acidic, and requires pH adjustment, caustic transfer pumps P-11 and P-12 are installed to recirculate a caustic stream that, when necessary, is added into TK-1. The controllers control the caustic feed to TK-1, with two controlled module valves. Each valve is controlled independently with its own pH probe and controller. One valve has a gradual open/close position while the other valve has only full open/close positions for more rapid addition.

D. Transfer Pumping Systems (P1, P2, P3 and P4)

The Transfer Pumping System consists of four vertical centrifugal lift pumps and six level sensors. The level sensors' LAL, CL, L1, L2, LWL and LAH are installed at 13", 19", 25", 31", 37" and 43" from bottom of the transfer tank respectively. When the wastewater level in the transfer tank, as measured by the tank level sensors CL, L1, and L2, reaches the respective operating level, the transfer pumps (P1, P2 and P3) will progressively turn on and transfer more wastewater from the transfer tank to the active pH neutralization tank (T-2). When the wastewater level in the transfer tank reaches the LWL level, the transfer pump P4 will also turn on and transfer wastewater to the pH neutralization tank (T-2) and the initial alarm will sound. When the wastewater level in the transfer tank reaches the LAH level, then the high level alarm will sound. When the wastewater level in the transfer tank reaches the LAL level, then all the pumps will shut-off.

E. pH Neutralization System

1. General

The neutralization system is a double-stage treatment process utilizing two pH treatment buffer tanks (T-2 and T-3). Each buffer tank is equipped with a pH controller which controls chemical additions; acid/alkali feed piping for neutralization; and a mixer to ensure homogeneous reactions take place.

Each neutralization tank is a polypropylene tank with a working volume of 7000 gallons. Average daily flows vary between 50 and 150 gallons per minute (gpm) over a process day. Wastewater is transferred by the transfer pumping system to the neutralization tank T-2 at an average rate of 100 gpm, and higher flow rates up to 600 gpm maximum. Acid or alkali addition is determined based on the pH of the wastewater as detected by the pH controller. Wastewater is then

transferred to the neutralization tank T-3 by gravity for further pH adjustment. From there wastewater flows to a holding tank then either through a plate and frame heat exchanger or directly to the discharge. Recovered heat is used to heat city water, which is used in the high purity water manufacturing process. The final effluent is then discharged to the District's sewer system. A final pH chart recorder, temperature chart recorder, Flow Totalizer and a sampling port are installed on the effluent pipe to monitor the effluent.

2. System Components & Controls

a. pH Treatment Process Wastewater Tank (TK-1)

Tank TK-1 has a maximum level capacity of approximately 2080 gallons with a length of 13'-4", width of 6'-3", and a height of 4'-0". The tank is constructed of polypropylene and equipped with six (6) level sensors (LAL, CL, L1, L2, LWL and LAH) to control the pumps. Four (4) vertical centrifugal lift pumps (P1, P2, P3 and P4) capable of transferring approximately 150 gpm each to the neutralization tanks, are installed on the tank. The tank is also equipped with one (1) pH probe and controller which control chemical additions.

b. Regenerant Acid Waste Storage Tank (TK-6)

Tank TK-6 has a maximum level capacity of approximately 21,000 gallons with a diameter of 11'-9" and a height of 26'-8". The tank is constructed of fiberglass reinforced plastic (FRP) and equipped with two (2) centrifugal transfer pumps (P-5 and P-6) capable of transferring approximately 40 gpm of 4 wt% acid solution each to the neutralization tank T-2 for pH adjustment or, if necessary, for treatment.

c. pH Adjustment Tanks (T-2 and T-3)

Tanks T-2 and T-3 have a maximum level capacity of approximately seven thousand (7000) gallons with a diameter of

10'-4" and a height of 11'-10". Each tank is constructed of polypropylene and at a maximum process flow of 600 gpm can provide a retention time of approximately 20 minutes within the two tanks.

The contents of tanks T-2 and T-3 are agitated by top entry mixers M-1 and M-2 respectively, which have a 1/2 horsepower motor turning an impeller-type mixing blade. The mixer provides for complete contact of the influent wastewaters with the neutralization chemicals supplied by the chemical feed pumps. Both mixers are controlled by mixer "START" and "STOP" push bottoms located at the control panel. During normal operation the mixer is in the "START" selection. The operator can manually switch the mixer to either the "START" or "STOP" mode.

Tanks T-2 and T-3 are equipped with pH sensors/analyzers which continuously monitor the pH of the contents and provide the operator and chemical feed equipment with continuous information. Each pH sensor provides for feed forward automatic control for the introduction of either acid or alkali chemical supplied by chemical feed pumps P-10 or P-11 and P-12. All chemical feed pumps are March Manufacturing, Inc. Model TE-7.5K-MD with inlet size of 1-1/2" and outlet size of 1".

During normal operations the operator sets the chemical pumps in the "AUTO" operation mode. If the neutralization tank pH is below a preset low level, the pH controller will modulate the control valve for the caustic chemical feed line and allow introduction of alkali into tank T-2 or T-3. Conversely, if the pH

of the waste stream is above a pre-set high level, the pH controller will modulate the control valve for the acid chemical feed line and allow introduction of acid chemical into tank T-2 or T-3. An adjustable "dead band" is provided on the pH controller to prevent the two control valves from cycling against each other. When the pH level is within the acceptable "dead band" pH range, neither control valve is activated.

If the normal power is lost, the emergency generator will provide power to operate the system. If the pressure in the compressed air line drops below 90 psi, nitrogen gas is fed through the line, serving as a backup. This allows the air diaphragm pump to operate. This pump will be activated if pumps P-1, P-2, P-3 and P-4 are unable to pump the wastewater out of tank T-1 causing it to overflow. A gasoline powered pump is also available to pump the wastewater if the diaphragm pump does not work.

After flowing through a heat exchanger, to recover heat for heating city water used to make high purity water, final neutralized wastewaters from the neutralization tank are continuously discharged to the District's sewer system.

d. System Operational Parameters

During normal operation of the neutralization system, the following operational parameters should exist:

- (1) The pH in tank TK-1 should be maintained between the desired range of approximately 2 and 14 standard units.
- (2) The pH in tank T-2 should be maintained between the desired range of approximately 3.5 and 10.75 standard units.
- (3) The pH in tank T-3 should be maintained between the desired range of approximately 6.5 and 10 standard units.

Under normal operation:

<u>Equipment</u>	<u>Operational Status</u>
P-1	"AUTO"
P-2	"AUTO"
P-3	"AUTO"
P-4	"AUTO"
P-13	"AUTO"
P-10	"AUTO"
P-11 or P-12	"AUTO"
M-1	"ON"
M-2	"ON"

e. Chemical Supply Equipment

The normal source of Sulfuric acid for pH adjustment is the 4% solution from the regenerant waste storage tank TK-6. If this waste acid is not available, Sulfuric acid from the bulk 93% storage tank is metered and diluted into reverse osmosis (RO) reject water to make a 4% solution for pH control. This solution is then supplied to the neutralization tank (i.e., T-2 or T-3) using chemical feed pump P-7. Sodium Hydroxide is supplied from chemical storage day tank TK-5, which has a capacity of 900 gallons. The bulk caustic storage tank transfers the 50% sodium hydroxide to the caustic day tank (TK-5) where it is then diluted to 4% solution for pH control. Chemical feed pumps P-11 or P-12 recirculate hydroxide chemical solution from tank TK-5 through a loop that returns to the day tank or feeds to the wastewater tank (T-1) and/or the neutralization tanks (i.e., T-2 or T-3). Motorized control valve opening rates are preset and activated by the pH controller for chemical feed at the respective tanks T-1, T-2 and/or T-3.

Each motorized control valve has a pre-set opening rate. The valves are activated by a signal received by the valve from the pH controller for that neutralization tank.

F. Effluent Monitoring

Treated effluent from the Neutralization System will subsequently flow by gravity to the District's sewerage system. As required by the conditions of Allegro's existing District's permits, the discharge rate, temperature, volume and pH are logged by the wastewater treatment operator. Should the wastewater pH fluctuate outside the effluent limitations for more than 15 minutes, the operator will notify the District until the pH returns to an acceptable level.